

# **Third Semester Undergraduate Research in Biochemistry & Molecular Biology (BMB)**

## **Guidelines and Expectations for both Students and Research Mentors within or outside of the BMB Program (BB 352 and BB 452)**

The [general guidelines](#) for all courses for credit in undergraduate research and/or honors are applicable to this course and should be incorporated with the following guidelines that pertain the earning general education credit for taking this course.

### **Responsibilities of the Student:**

*HUB requirements:* Earning general education units involves the ongoing efforts made during your first two semesters or units of research experience. This includes continuing required attendance and participation in laboratory meetings on a regular basis, and the continued experience and use of the online research information and literature is expected. This semester there are additional requirements for earning HUB units in WIN and CRI during your third semester research course.

### **Responsibilities of All Research Mentors:**

By the third semester of research, mentors should challenge students in their research. Mentors are required to respond to students' projects in a way that forces the students to think outside of the box, pursue new ideas, or take risks.

### **General Education (BU Hub)**

#### **1. Writing-Intensive (WIN):**

Learning Outcome 1: Students will be able to craft responsible, considered, and well-structured written arguments, using media and modes of expression appropriate to the situation.

Learning Outcome 2: Students will be able to read with understanding, engagement, appreciation, and critical judgment.

Learning Outcome 3: Students will be able to write clearly and coherently in a range of genres and styles, integrating graphic and multimedia elements as appropriate.

The training in discipline specific writing started in the first semester of research during the application process, and continued in the second semester with a more in-depth scholarly application. For the student's training in the Writing-Intensive Hub unit in the third semester of undergraduate research, students will work with their mentors developing and revising their research proposal, including several drafts, prior to enrollment (as was done in the applications for prior semesters). As mentioned, this

proposal will build on the proposals written for enrollment in their first two semesters. The first semester included writing an informative title and abstract concerning the general objective of the laboratory and annotated bibliography. The second semester included an updated abstract, which included defined research project in which the student will be involved, as well as a detailed a well-cited introduction describing the research problem, ending with a clearly written hypothesis. For registration in the third semester, students will be required to re-write the proposal, but crafted in a well-structured written proposal in the form of a grant proposal. It is expected that by the third semester, students will have a deeper understanding, appreciation, and critical judgement of the project in which they are engaged. This proposal will allow for the incorporation of feedback, both scientific and stylistic, of previous versions from mentors and co-workers. This proposal will include, in addition to the components required for the second semester, a set of aims that will describe how their hypothesis will be tested and the data analyzed. All parts should be well cited and include an extensive annotated bibliography. It is expected that progressive feedback is given by mentors and the program as these proposals develop from semester to semester.

Additionally, beginning in the first semester of research experience, students should receive instruction on proper ways for keeping a scientific notebook consistent with the expectations in the laboratory. This ongoing writing experience should continue in the third semester. At all times during their time in the laboratory, feedback should be provided on the writing of a proper notebook. By the time the third semester is in progress, student should have demonstrated this art through the iterative feedback from mentors and co-workers.

Lastly, students in the third semester will be required to complete a writing assignment at the end of the semester. This assignment will include drafts with feedback from mentors and will be in a different genre from the previous two writing exercises; that of a scientific progress report. This progress report will be based on the initial proposal submitted for enrollment. This report will comprise part of their semester grade from their research mentor. As a scientific report, it will likely incorporate multiple elements common to research papers such as tables of data, figures of analyzed results, and diagrams of methods used in the research process. Additionally, throughout the entire research process up to this point, students will already have learned appropriate research information literacy, and reading related and representative scientific literature that will help compose their report. Lastly, these papers writing will be submitted to the Research & Honors Committee for use in program assessment.

## 2. Creativity/Innovation (CRI):

Learning Outcome 1: Students will demonstrate understanding of creativity as a learnable, iterative process of imagining new possibilities that involves risk-taking, use of

multiple strategies, and reconceiving in response to feedback, and will be able to identify individual and institutional factors that promote and inhibit creativity.

*Learning Outcome 2:* Students will be able to exercise their own potential for engaging in creative activity by conceiving and executing original work either alone or as part of a team.

Those students who continue as juniors or seniors in a research laboratory for a third semester will earn another CRI unit. By the time students are participating in their third semester of research, they are expected to be able to develop more complex and innovative research projects. Application of the CRI learning outcomes will be especially important as more extensive research in the third semester typically encounters new challenges that must be overcome, often with minimal guidance from the literature. Students are required to devise answers to problems that have never been posed before, problems whose answers cannot be found through Google. The third semester of research truly enables students to creatively apply their earlier research experiences to their current research projects, be they the design of a new method, the testing of new wrinkle in an established experimental procedure, or the design and testing of new computer modeling algorithms. Students in their third semester of research are expected to display a greater degree of independence and begin to take ownership of the direction of their research project. Having performed undergraduate research for a third semester, students will have developed the patience and persistence over time in doing their project(s). This time enables creativity to come to fruition. Research is a natural incubator for developing creative thought and students should be allowed this time with mentors challenging students to go beyond what they are learning as more experience in research is gained. Given this time, students should grow into leadership roles within a research group, and their creative ideas contributing to the project.